INTRAOCULAR LENS WITH MINIATURE OPTIC HAVING EXPANDABLE AND CONTRACTIBLE GLARE-REDUCING MEANS

This invention relates to intraocular lenses for the human eye, and, more particularly, to intraocular lenses of the type which can be positioned in the anterior chamber, the posterior chamber, or partially in the anterior chamber and partially in the posterior chamber of the eye. The invention also relates to methods of inserting such lenses in a eye.

One type of intraocular lens is described and claimed in my U.S. Pat. No. 4,253,200 issued Mar. 3, 1981. Such a lens is inserted into the eye through a corneo-scleral incision that may be also used to remove a natural lens. To minimize the possibility of injury to the eye, it is important that the incision be made as small as possible. According to that patent the size of the incision is dependent nearly entirely on the diameter of the optic. In order to further reduce the size of the incision, therefore, the size of the optic would have to be reduced. This can be accomplished in several ways. First, the optic may be made in the form of a twopiece optic, allowing the surgeon to make an incision in the eye smaller than the diameter of the lens body, or optic, and inserting the two parts of the optic separately through the incision. In the case of the two-piece optic, depending on where the optic is split and depending on the means used for connecting the two pieces together there may result, in some instances, an undesirable glare effect at the juncture of the two pieces. A second possibility is to form the lens with an optic of reduced size, at least in the one dimension thereof which must pass through the incision. However, the undesirable glare effect described above has in the past also precluded the use of such optics which were substantially smaller than 5 mm in diameter, or at least had one dimension (transverse to the optical axis) of such substantially smaller size. The reason was that some of the light rays entering the eye would impinge on the peripheral marginal regions of such miniature optic which, because of the small dimensions involved, are located in the path of such light rays and would scatter the rays toward the retina.

A further possibility is to form the optic out of a flexible material such as silicone and to curl the optic into the shape of a small cylinder which can then be readily inserted into a small incision. This latter construction requires that the curled optic fully assumes its flat initial shape after it is inserted into the eye. Any deviation from such flat shape would result in optical distortion.

Also, if the material used for such flexible optic is silicone, materials in the eye, such as, for example, fibrin, may collect on the optic due to the surface characteristics of silicone. It is therefore preferred to make the optic out of a material such as polymethylmethacrylate (PMMA) which is not only relatively rigid but also does not have properties which cause any of the materials in the eye to adhere thereto. PMMA's physical properties are such that fibrin and other materials in the eye are constantly washed away from its surface rather than adhering thereto.

It is an object of the present invention, therefore, to provide a new and improved intraocular lens which avoids one or more of the limitations of prior such lenses.

It is another object of the invention to provide a new and improved intraocular lens which has a lens body which is smaller, in at least one transverse dimension thereof, than the lens body of conventional lenses, yet which does not result in undesirable glare.

Glare effect is produced whenever there is located, in the path of the light rays which pass through the pupil to the retina, an edge or similar boundary between regions which are both substantially transparent as distinguished from one being substantially opaque. For example, glare effect will result if a lens body is split into two parts along, e.g. a diameter, or if an optic has a 3 mm diameter while the bundle of light rays passing through the pupil has a transverse cross sectional area which is 6mm in diameter, since the outermost rays will pass through the optically transparent fluid in the eye while the innermost rays pass through the optic. No such edge glare results however in those cases in which one side of the edge or boundary in question is masked, i.e. is opaque, such as for example, the boundary formed by the iris at its inner edge defining the pupil. The opaque iris thus masks without causing glare effect.

In accordance with the invention an intraocular lens comprises a lens body and a position-fixation means extending from the lens body for fixating the lens body within the eye. The lens body is of minature size, i.e. it has at least one dimension sufficiently small in size to permit the lens to be inserted into the eye through an incision which is substantially smaller than the incision now generally required for insertion of conventional lenses. The lens also includes a deformable masking means integral with the lens body for preventing glare-effects when the masking means is in expanded condition. For insertion, the masking means are deformable into a contracted condition in which they pass, together with the lens body, through the desired substantially smaller incision.

In accordance with the invention an intraocular lens comprises a lens body for focusing light rays on the retina of an eye, the lens body has a pair of imaginary coordinate axes at right angles to one another and to the optical axis and has a maximum dimension of substantially less than 5 mm along any line drawn through the lens body parallel to a given one of its pair of coordinate axes, said maximum dimension being defined by a pair of opposite peripheral edge portions of the lens body transverse to said one coordinate axis and located apart a distance equal to said maximum dimension, and masking means integrally connected with the lens body and deformable between an expanded condition in which the masking means has a first portion thereof adjacent one of said peripheral edge portions of said lens body and a second portion thereof spaced from and located radially outwardly of said one peripheral edge portion of said lens body for inhibiting light rays which are directed toward said peripheral edge portion from being scattered thereby toward the retina after the lens has been implanted in an eye, and a contracted condition in which said masking means are located substantially entirely within said maximum dimension of said pair of opposite peripheral edge portions of said lens body for permitting insertion of said lens through an incision in an eye which is substantially less than 5 mm in length.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description, taken in con-